Streambank Protection

General

This practice consists of protecting eroding streambanks or excavated channels against scour and erosion by using vegetative or structural means, or a combination thereof. Examples of commonly used structural measures are riprap, concrete, and gabions. These measures help prevent the loss of land, protect property, control stream meanders, and reduce silt deposition in downstream areas.

Streambank Protection

Definition: Using vegetation or structures to stabilize and protect banks of streams, lakes, or excavated channels against scour and erosion.

Purpose: To stabilize or protect banks of streams, lakes, or excavated channels for one or more of the following purposes:

1. To prevent the loss of land or damage to utilities, roads, buildings, or other facilities adjacent to the eroding area.

2. To maintain the capacity of the channel by the use of revetment or mechanical facing of ditch or streambanks and auxiliary measures for protection against scour and erosion.

3. To control channel meander which would adversely affect downstream facilities.

4. To reduce sediment loads causing downstream damages and pollution.

Streambank protection is most commonly provided by rock riprap.

5. To improve the stream for recreation or as a habitat for fish and wildlife.

Conditions Where Practice Applies: This practice applies to streams, lakes, or excavated channels where the banks are subject to erosion from the action of water, ice or debris or to damage from vehicular traffic.

It applies where streambank erosion causes damage to land, water resources or real property. It also applies to controlling erosion on shorelines where the problem can be solved with simple structural measures, vegetation, or upland erosion control practices. It is applicable where failure of structural measures will not create a hazard to life or result in serious damage to property.

Planning Considerations

Water Quantity: The following effects on water quantity should be considered.

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, deep percolation, and ground water recharge.

2. Effects on downstream flows and aquifers that affect other uses and users.

Water Quality: The following effects on water quality should be considered.

1. Filtering effects of vegetation on movement of sediment, and sediment-attached and dissolved substances.

2. Effects on erosion and movement of sediment, and soluble and sediment-attached substances carried by runoff and streamflow.

3. Effects on the visual quality of onsite and downstream water resources.

4. Effects of construction and vegetation establishment on quality.

5. Effects of changes in water temperatures.

6. Short-term and long-term effects on wetlands and water-related wildlife habitats.

Design Criteria

Since each reach of channel, lake or stream is unique, measures for streambank and shoreline protection must be installed to a plan adapted to the specific site.

Streambank protection measures will be designed to withstand the velocities and forces to which they are subjected. They will be designed according to procedures contained in SCS Technical Release 25 or Highway Research Report 108 (Tentative Design Procedures for Riprap-lined Channels). Procedures contained in *Bank and Shore Protection in California Highway Practice, November 1970* may also be used.

On uniform streams with drainage areas of 640 ac. or less and stream velocities of 12 fps or less, procedures contained in Chapter 16 of the SCS Engineering Field Hand-

book for Conservation Practices may be used. Stream velocities can be determined using Manning's Equation with appropriate values of "n".

Channel flow restrictions such as narrow cross sections, rock ledges, culverts, bridges, etc., will necessitate a detail water surface profile determination for realistic capacity computations. All channels which have restrictions mentioned above, regardless of drainage area size, shall have detail water surface profile calculations. The consideration of changes in velocity head between sections may be disregarded when they are insignificant.

Structural measures will be designed to extend to the elevation of peak flow from a 5-yr.—24-hr. storm or bank-full flow, whichever is the least. However, if structural measures do not extend to the top of the bank, they will be stable at bank-full flows.

Toe scour will be controlled by either natural or artificial means or the bank protection will be constructed to a depth below the anticipated lowest depth of bottom scour. The minimum depth of scour protection below the stream bottom will be 1.0 ft. for streambank protection measures less than 4 ft. high, and 2.0 ft. for those measures greater than 4.0 ft. high.

Measures will begin and end at stabilized or controlled points on the stream. Ends of revetments, bulkheads, jetties and groins shall be keyed into the bank a minimum depth equal to the height of the bank protection.

Needed channel clearing to remove stumps, fallen trees, debris and bars which force the streamflow into the streambank shall be an initial element of the work.

Control of surface runoff and internal drainage shall be considered in all designs.

Channel alignment changes will meet the requirements of the standard for open channels.

Vegetative protection shall be considered on the upper portions of eroding banks and especially on those areas which are subject to infrequent inundation. For uniform streams with drainage areas of 640 ac. or less, the allowable permissible velocities shall be as established in Table 4 of the standard for grassed waterways.

Vegetative measures shall conform to requirements contained in the applicable standard for seeding and planting. Side slopes will be no steeper than those shown below.

Material	Side Slope
Sand or silt with clay binder	2:1
Heavy clay or silty clay	1 1/2:1
Gravel, clean	2:1
Sand, clean	1:1
Solid rock	1/4:1
Loose rock or cemented gravel (cut)	1:1

All streambank protection measures shall be compatible with improvements planned or being carried out by others.

The following is a partial list of elements that may be included in a plan for streambank protection:

1. Removal of fallen trees, stumps, debris, minor ledge outcroppings, and sand and gravel bars that may cause local current turbulence and deflection.

2. Removal of trees and brush that adversely affect the growth of desirable bank vegetation.

3. Reduction of the slope of streambanks to provide a suitable condition for vegetative protection or for the installation of structural bank protection.

4. Placed or dumped heavy stone, properly underlaid with a filter blanket, if necessary, to provide armor protection for streambanks.

5. Deflectors constructed of posts, piling, fencing, rock, brush, or other materials that project into the stream to protect banks at curves and reaches subjected to impingement by high velocity currents.

6. Artificial obstructions, such as fences, to protect vegetation needed for streambank protection or to protect critical areas from damage, stock trails, or vehicular traffic.

7. Reinforced concrete, masonry, sacked concrete, rock-filled wire mesh gabion baskets, concrete or wood cribs, piling, grouted rock riprap, precast paving blocks and other structures that provide armor protection to the streambank or deflect erosive flows.

8. Lining the streambank with vegetation, either with a vigorously growing shrub, grass, or trees, or a combination of them. For further information on individual species, see the standard for seeding and planting.

Environmental Criteria

Fish and Wildlife: Special attention shall be given to maintaining or improving habitat for fish and wildlife.

Landscape Resources: Consideration shall be given to the use of construction materials, grading practices, vegetation, and other site development elements that minimize visual impacts and maintain or complement existing landscape uses such as pedestrian paths, climate controls, buffers, etc.

Construction Activity: Where possible, streambank and shoreline protection measures will be designed such that construction activities can be performed from the bank. Erosion and sediment control measures such as diking, mulching, temporary seeding, etc. will be incorporated in the design.

Plans for the measure shall include provisions for disposal of woody material from clearing operations, excess excavated material, and other debris. Disposal methods and areas will be such that the material will be stable and cannot reenter the stream.

Operation and Maintenance

An operation and maintenance plan shall be prepared for streambank or shoreline protection measures. The plan shall include, as a minimum, the following items:

1. Provisions for annual inspections and inspections following every major storm event.

2. Repair, replacement or addition of structural or vegetative measures, where needed because of damaging high flows.

3. Removal of sediment bars, undesirable vegetative growth, or other stream obstructions that may be causing flow to be diverted into the protection measures.

Design Aids

Reference may be made to Figures 22 through 25 which provide details of different kinds of deflecting jetties.

Specifications

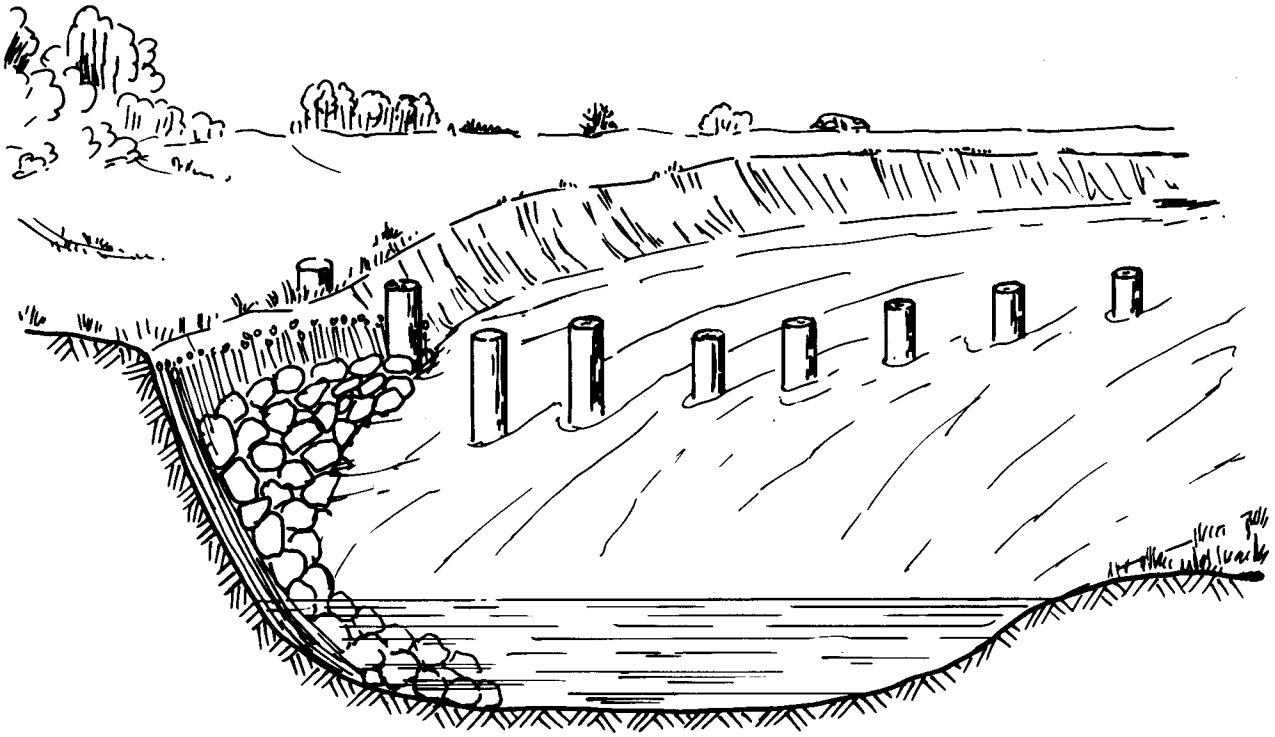
Measures and construction methods that protect fish and wildlife values shall be incorporated as needed and practicable. Special attention will be given to protecting and maintaining key shade, food, and den trees and to stabilization of disturbed areas.

The required removal of any trees and brush will be done in such a manner as to avoid damage to other trees and property.

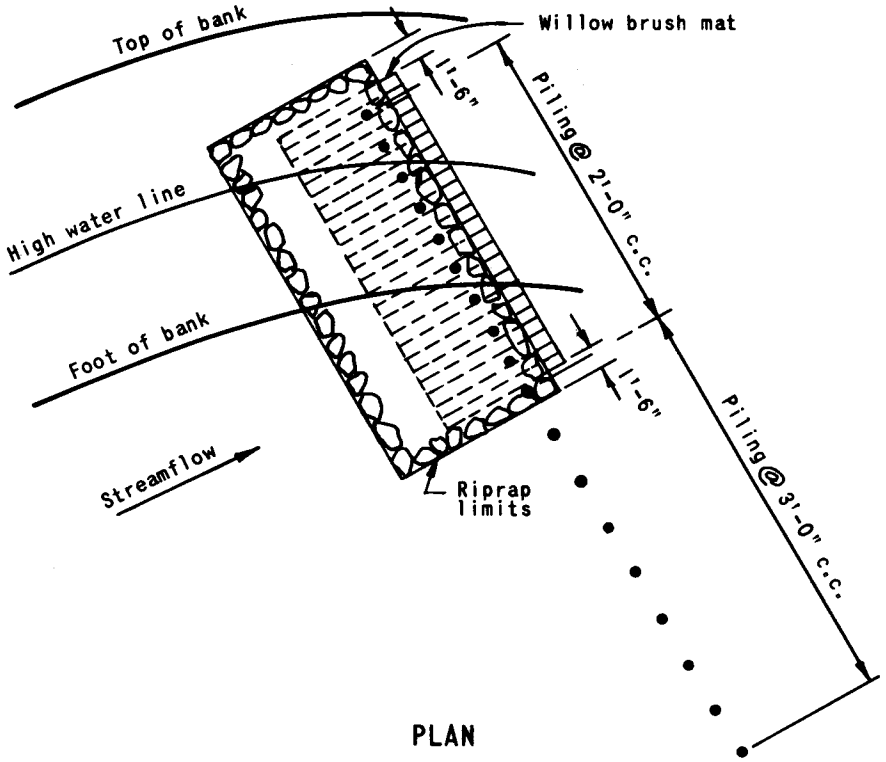
Disposal of trees, brush, and other material will be done in such a way as to have the least detrimental effect on the environment.

Construction operations shall be carried out in such a manner that erosion and air and water pollution will be minimized and held within legal limits.

The completed job should present a workmanlike finish.

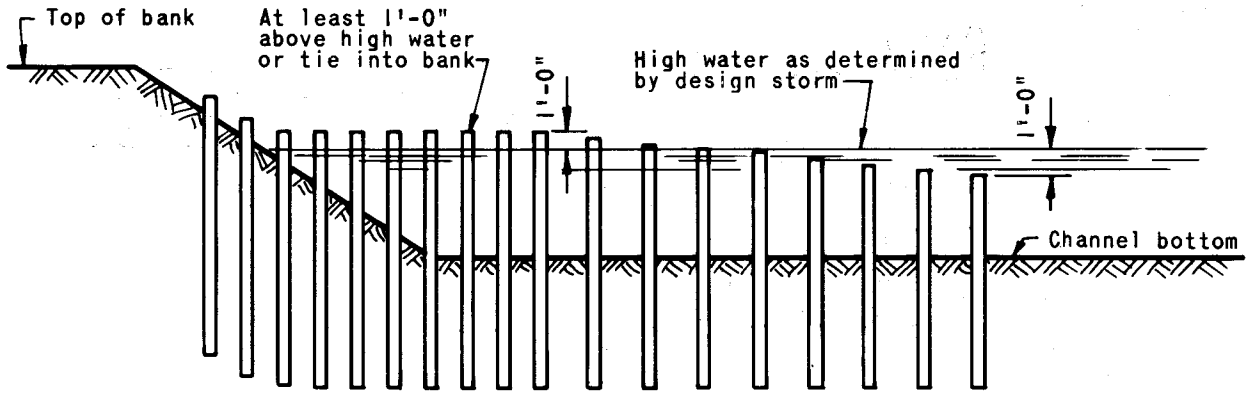


PERSPECTIVE VIEW



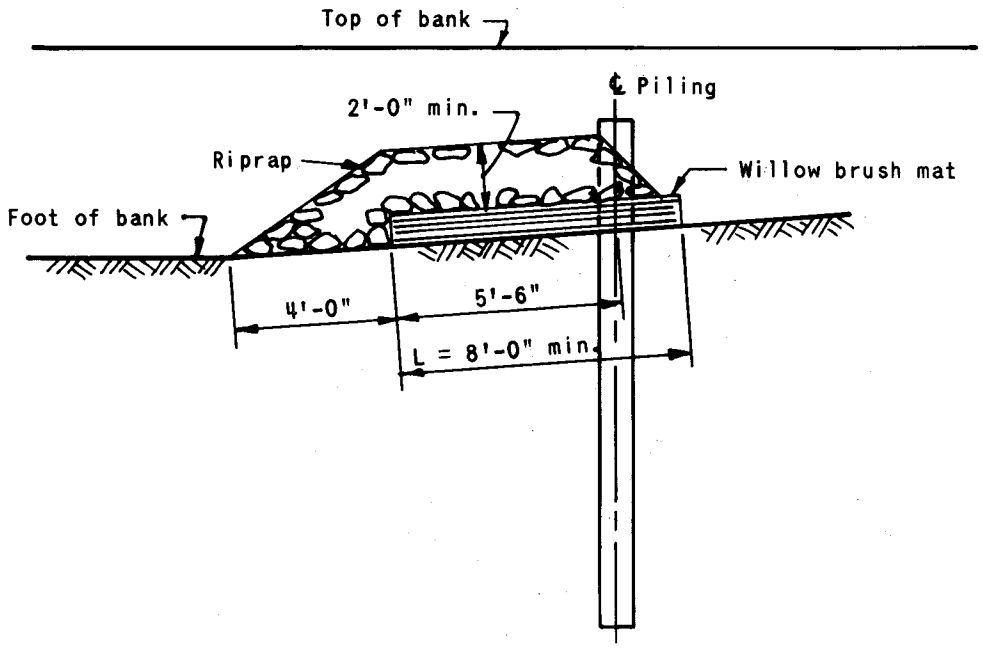
PLAN

Figure 22 — Brush, Riprap, and Pile Deflecting Jetty



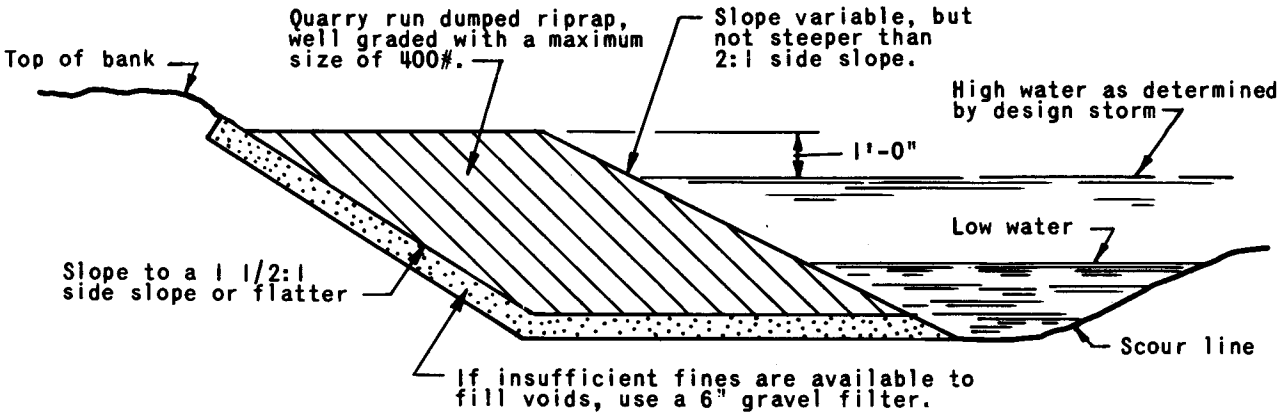
TYPICAL PILING INSTALLATION

BRUSH AND RIPRAP NOT SHOWN

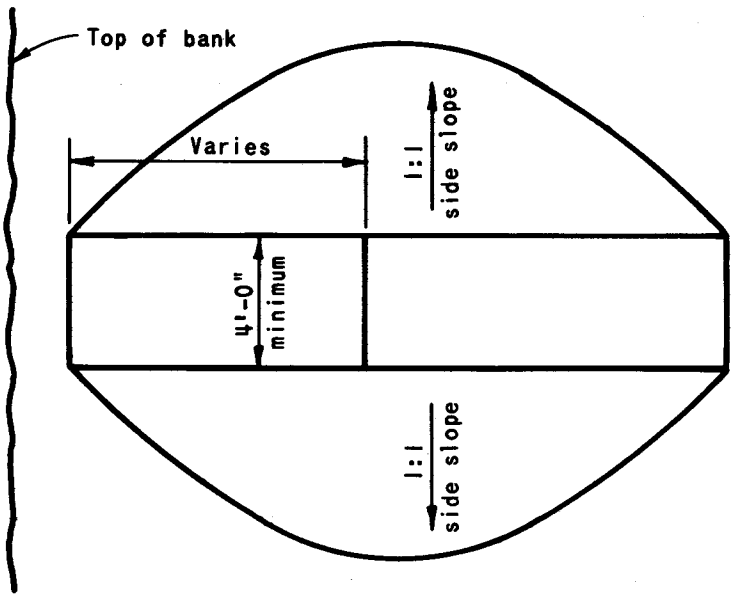


TYPICAL RIPRAP AND BRUSH MAT INSTALLATION

Figure 23 — Brush, Riprap, and Pile Deflecting Jetty

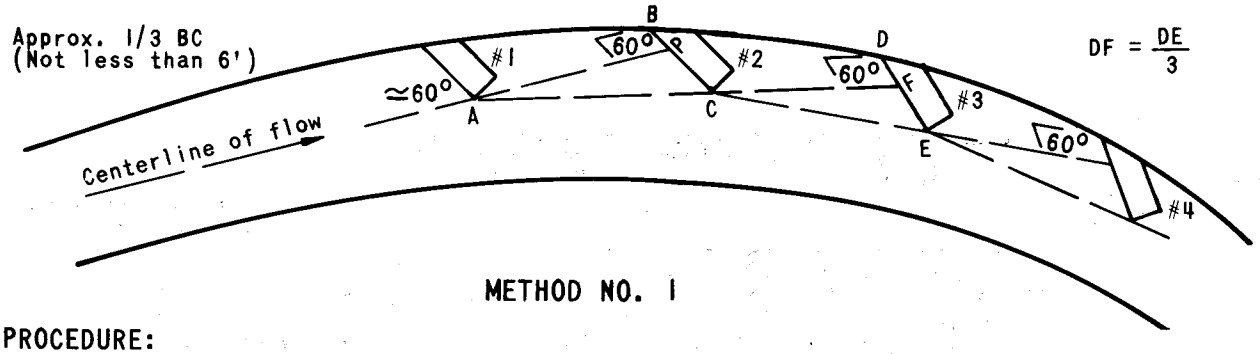


SECTION



PLAN

Figure 24 — Riprap Deflecting Jetties



METHOD NO. 1

PROCEDURE:

Step 1 - Draw centerline of stream in straight section upstream from eroded bank.

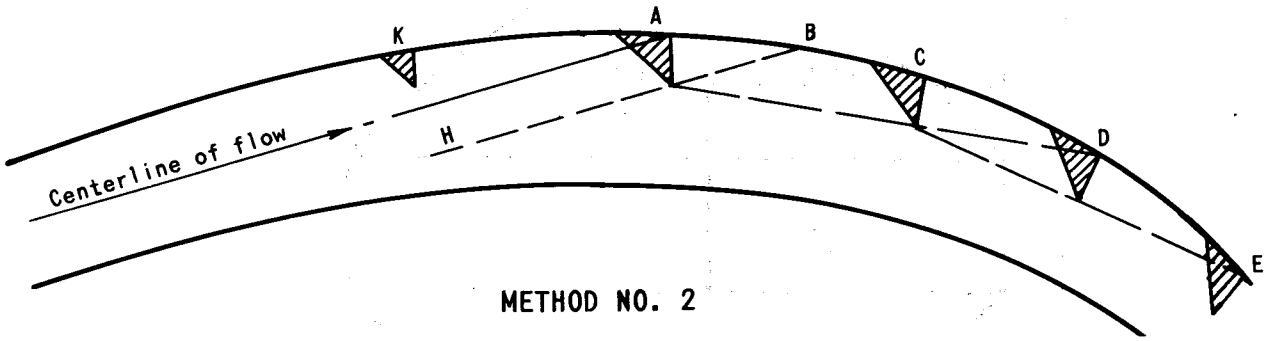
2 - Locate jetty #1 at the point of tangency or a short distance downstream therefrom.

3 - Locate jetty #2 by projecting a line AP parallel to the centerline of flow (step 1). The line BC is drawn so that the angle APB is 60 degrees and the distance BP equals 1/3 BC - but not less than 6 feet.

4 - Locate jetty #3 by projecting a line ACF through the ends of jetties 1 and 2 to DE. DF equals 1/3 DE and angle CFD equals 60 degrees.

5 - Successive jetties are located as per Step 4.

As a rule, jetty #1 is from 1/2 to 1/3 the length of the other jetties.



METHOD NO. 2

PROCEDURE:

Point "A", location of first jetty, is the intersection of the flow line and the eroding bank. Jetty "C" is located by drawing HB parallel to the flow line and across the toe of jetty "A". AC is twice AB. Jetty "D" is located projecting a line across the toe of jetties "A" and "C". The remaining jetties are located the same as "D". Supplementary jetty "K" located AC distance upstream from "A" should be approximately 1/2 regular size.

Generally, when curvature of the eroding bank exceeds 30 degrees (200 ft. radius or less), it is safer and more economical to use some type of revetment for protection instead of jetties.

Figure 25 — Method of Locating and Spacing Jetties